THE CULTIVATION OF THE CRICKET BAT WILLOW.

BY

W. R. Day, M.A., B.Sc.,

Imperial Forestry Institute, University of Oxford.

Introduction.—The farmer or forester, growing a crop for commercial purposes, and the research worker studying some particular aspect of crop production tend to hold somewhat different points of view with regard to methods of treatment and general culture. While one engaged in commercial production may think too much of the material to be obtained as the final crop and too little of the plant by means of which it is to be produced, the research worker, especially if he be a biologist studying the life of the plant and the general conditions affecting it, is apt to do the opposite and be so immersed in the theoretical conception of the conditions necessary for the crop as to forget, somewhat, the economic aspect. In dealing with the cricket bat willow, one is, however, concerned with a crop with regard to which little or no research has been done and the cultivation of which is carried out according to rules that have developed from the general experience of willow growers in the past. Now it is true generally, that though while the culture of any crop is not intensive, and the demands on it not great, cultivation according to rule of thumb may be sufficient, immediately the crop is grown more extensively and intensively, dangers from disease arise which often only serious research can explain and provide measures of prevention for. Now I think the cricket bat willow is a crop which has arrived at this stage when research should be made into the conditions necessary for its intensive cultivation and for the prevention of disease when so cultivated. It should be remembered that while willows of one kind or other have been utilised or grown as a crop from time immemorial the extensive cultivation of the cricket bat willow is quite recent and its development coincides with the great increase in the population of Britain during the last hundred years of industrial development and perhaps more especially during the last fifty years or even less. It is a quite common experience that during the first period of its extensive cultivation a crop is fairly free from disease, but that then diseases gradually accumulate until its requirements are understood and its true economic value appreciated. It is because

willow cultivation has reached this critical period that it is worth while discussing as simply as possible some of the factors affecting the life and growth of the willow, not, however, in order to lay down dogmatically the manner in which cultivation should be carried out, but to stimulate, if possible, on the part of willow growers a desire to enquire into and understand more fully the conditions under which willow-growing may be maintained profitably.

The cricket bat willow is not cultivated after the fashion of an agricultural crop; there is no special preparation of the soil, such as ploughing, manuring or cleaning. The cultivation is more as that of a forest or an orchard tree; one chooses a soil which is supposed to be good, plants the sets at what is considered to be a sufficient distance apart to allow of proper growth for the production of the type of timber required, prunes the set during the first few years and then trusts to Nature and good fortune to do the rest. It should be recognised that this type of cultivation is in many ways no cultivation at all. It is merely placing out trees to grow naturally in localities which will be good or bad for them according to the skill or luck of the grower in choosing sites for willow growing.

When thinking of planting willows, the first thing to decide, is, therefore, what is the right type of soil to plant on. The tree willows are, naturally, riverside plants, loving the deep moist alluvial soil to be found in such localities. Their light seeds germinate most easily on the silt deposited by floods or on any moist soil that is freshly exposed, as when a river changes its course or breaks down its banks On such sites they are among the first plants to appear, but if the site is to remain for any length of time above water will, as the soil dries out, be replaced by whatever may be the prevailing types of forest tree, in the locality. The tree willows are therefore plants which occur naturally under special conditions only to be found along the sides of rivers or lakes. They are definitely associated with moist alluvial soil, which is never subject to drought, but which is always well aerated, and in which the water is never stagnant. Such soil is being constantly refreshed by the silt deposited by winter floods, and it is in this silt that the willow seeds find a place for germination.

Cultivated Sites.—If the sites in which the cricket bat willow is planted are considered it is found that they fall roughly into three divisions.

1. The Riverside. — Judging from the localities in which willows naturally do best the riverside should be the best site for willow growing, and undoubtedly it often is.

Even here, though, planting should be done with discretion. For the riverside may be water-logged, in which case it is unsuitable unless it can be efficiently drained; or it may be a heavy clay which is by no means always a suitable soil, although willows sometimes do well on it, especially if drainage is carefully attended to. Then it is common to find gravel on such sites, either to provide towing path or deposited as a result of river dredgings. Such gravel often makes a very poor soil and one unsuited to willows; it should be avoided until proved, for the willow is a shallow rooting tree, and twelve inches of poor surface soil may be more than sufficient to make a site unsuitable.

2. The Swamp or Bog.—A favourite site for the planting of willow is swampy or boggy ground, a certain amount of which always occur on low lying land. Such land is useless for agricultural purposes, and since willows are known to tolerate a great amount of water it is assumed that here is the place to plant them. This is quite wrong, as a rule. Willows may be moisture-loving plants, but they do not love water-logged soil, and if such sites cannot be drained they should not be planted up. Where, however, the land does not lie permanently water-logged it may be possible with a little trouble to make it into good willow-land.

3. The Water-meadow and Hedgerow.—With so profitable a crop as the cricket bat willow, it is inevitable that an attempt shall be made to grow it elsewhere than immediately along the waterside or in wet places where it might occur naturally, and it is now to be found along the hedgerows or in small groups or plantations in the water-meadows and lower lying arable land. Sometimes very good willow is grown in such places, and they are to be considered as being possible suitable sites. Success or failure depends on whether or not the conditions comply with the demands made by the willow on water supply, and fertility of soil. In the water-meadows or fields adjoining a river or stream the soil conditions are often similar over a very considerable area, and here undoubtedly the willow may be extensively planted with great success. Sometimes willow is planted along the hedgerows of fields lying on the lower slopes of the hills. Such fields may have an abundant water supply owing to the seepage of water down from the higher land and given a favourable soil good willow can then be grown. In such places, however, it does not do to assume that because sets are planted alongside a running ditch, or because land grows good corn, that of necessity good quality willow will be produced. The willow grows most quickly and does best on land that is not merely moist, but which has a high water-table, and where even in summer there is

no shortage of water. Also, if the fast growth is to be obtained by means of which alone the best wood is produced the soil must be really fertile. The requirements of the tree are then a perpetually moist well aerated and fertile soil.

Type of Set and Root Development.—There is sometimes some discussion as to which is the best to plant, rooted or unrooted sets. This is a matter on which I have no experience. Opinion varies, but the majority seem to consider that unrooted sets grow faster and produce timber quicker than do rooted ones. Actual proof one way or the other can, of course, only be obtained by careful measurement of sample trees.

It is, perhaps, worth while to look at the root system developed by the two types of sets after being planted out

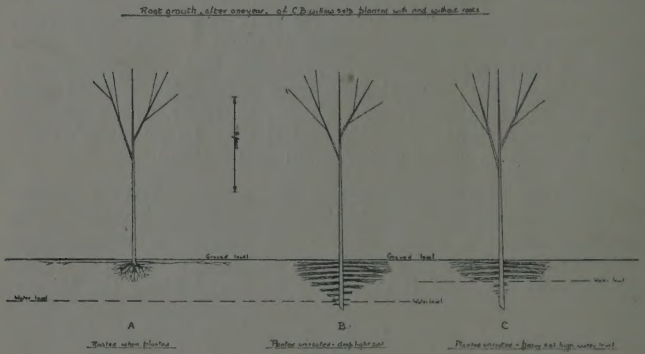

FIG. 1.—Root growth of willow sets one year after planting out. A a rooted and B an unrooted set on deep light loam. C an unrooted set on heavy soil with a high water level.

in the field for one year. It will be seen from Fig. 1 (A and B) that they are very different. The rooted set is, of course, transplanted from the nursery with all its big roots broken, and many others probably injured, and it has to make what is really a new root system. In so doing it produces two kinds of roots, the one short and fibrous making a ball of perhaps 3ft. in diameter at the base of the stem, the other long and big, growing immediately under the surface of the soil and reaching out, in this case, over a circle 12ft. in diameter. The unrooted set is a great contrast to this. For one thing, the set is planted twice as deep or even deeper into the ground than the root-system of the rooted set. Then it develops numerous roots all round the stem, none of them fibrous, and all growing straight out into the soil. It

is to be noted that although roots have grown out all down the buried part of the set only those in the top 18ins. are of any real length, and as a matter of fact it is these that will develop into the root system of the tree. It is obvious from this that so far as root development is concerned sets need be planted not more than twelve inches deep, and that the remaining 18 inches or 2ft. to which they are usually set is required merely to ensure mechanical stability. The set here illustrated grew in a light sandy loam, and if one grown in a heavy soil is taken instead, the surface development of the root system is much more obvious. This is shown in Fig 1 (C). Here there has been no root development on the lower end of the set.

If one may assume it to be true that, at least during the first years after planting the unrooted set grows the faster, then it may be asked, what is the reason for this. I think it is to found in the root systems of the two types of set. Assuming favourable soil and climatic conditions, the size of root system developed by a set in the first year after planting will largely depend on the amount of food reserves available to assist the growth of root and shoot once the growing season has begun. The unrooted set, coming straight from a vigorous fast-growing mature pollard will nearly always have the advantage in food reserves, over the rooted one, which will have spent its store in getting established in the nursery only to have its root system broken up and disturbed in transplanting. It is important to realise that the rate of growth of a tree largely depends on the size of the root and that,other things being equal,the tree with the best developed root will grow the faster because it is able to supply itself more generously with the nutrient salts necessary for its existence.

The Importance of the Planting Distance.—One of the most important things in willow growing is that the sets shall be planted at the right distance apart. If the planting distance is too great or too small the soil is not being exploited to the best advantage. No willow grower I think, is liable to succumb to the temptation to plant trees too far apart. On the contrary, my experience is that very many growers do quite definitely plant too closely. It is by no means an easy thing to say exactly what is the best distance apart at which willows shall be set, and I am prepared to make no arbitrary statement about it. It is a matter which can only be decided by experience and with regard to which statistics from sample plots need to be collected. Nevertheless it is necessary to come to some conclusion on the matter, and to get some idea as to what a variation in the planting distance means to the tree.

The rate at which a tree grows, given constant soil and climatic conditions depends upon two things; first the development of the root, second that of the crown. If the

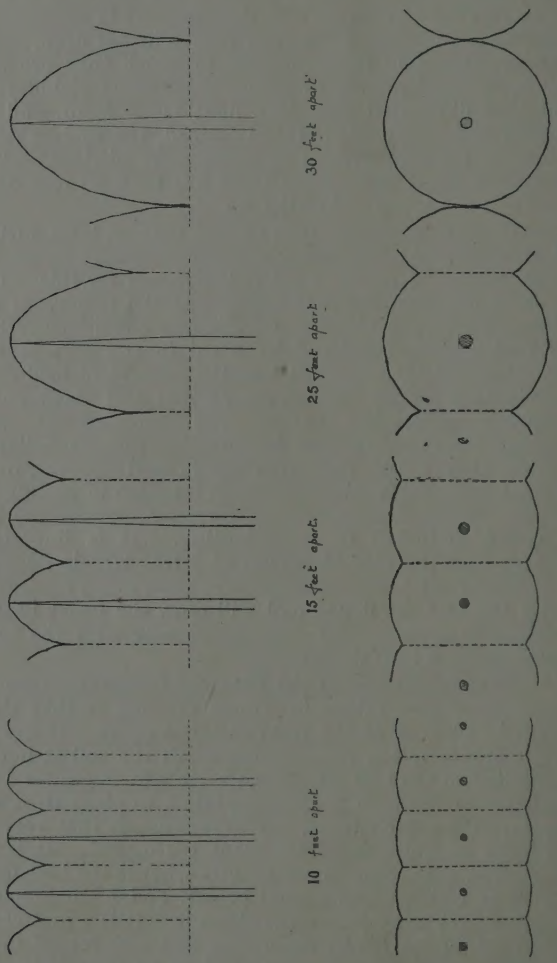

FIG. 2.—Diagram showing the effect of planting distance on the crown-development of trees planted in single lines.

development of either root or crown is encouraged or restricted by any particular cultural practice, then the rate of growth will correspondingly increase or decrease. The

distance apart at which trees grow directly affects both root and crown according as it makes competition for nutrient salts in the soil on the part of the root and for light, on the part of the crown, more or less severe. This is most easily seen by studying the effect of planting distance or crown development, 10ft. and 15ft. are the common planting distances in the Chelmer valley; 20 or 25ft. is sometimes met with, but 30ft., although recommended by some authors, is but very rarely adopted in practice so far as I have seen or heard. Fig 2 shows diagrammatically what is the effect on crown development of planting at distances of 10, 15, 25 and 30ft. At 10ft. and even 15ft. the crown of the mature tree is very much restricted; at 25ft. much freer growth is possible, while at 30ft. there is room for free growth all round. The thing to be noted is not merely that at the two smaller planting distances the crowns overcrowd each other when trees are mature, but that this overcrowding must have taken place for more than half the life of the tree. At 25ft. spacing the overcrowding is not nearly so serious since it only occurs during the last few years before the minimum size for felling is reached. This diagram is intended to represent trees of this size which is, I believe, about 11 inches quarter girth.

Now it is impossible to say which is the most profitable planting distance; such distance will probably vary slightly according as the fertility of the soil varies, and it can only be determined by measurement and calculation. In the meantime it has to be estimated at what minimum distance good quality fast grown willow will be produced. First, it should be plain that the fastest grown timber giving the quickest turnover will be obtained from trees that are entirely free to develop their crown; i.e., in the diagram planted 30ft. apart. The further advantage of planting so widely apart as this is that by so doing the healthiest conditions are obtained, for the willow is a tree of the class known in forestry as light demander, which require ample space for crown development, and are unable to withstand crowding or shading as e.g. can the beech. Among this class of trees, the willow is among the most extreme, demanding for good development plenty of growing space. It by no means follows, however, that good healthy willow may not be grown when trees are planted so that the crowns are not absolutely free. It is my own experience and certainly must be that of many that excellent willow is sometimes produced when trees are planted so close together as 10 or 15ft. Much depends on the quality of the soil and the order in which the trees are planted, and the extent to which the dominant trees suppress their neighbours. In single

rows the planting distance may be closer (see Fig. 3) than when trees are set in double or triple rows or in larger plantations for the trees are always quite free on two sides. In my opinion trees should in no case be set so close as 10ft. apart,

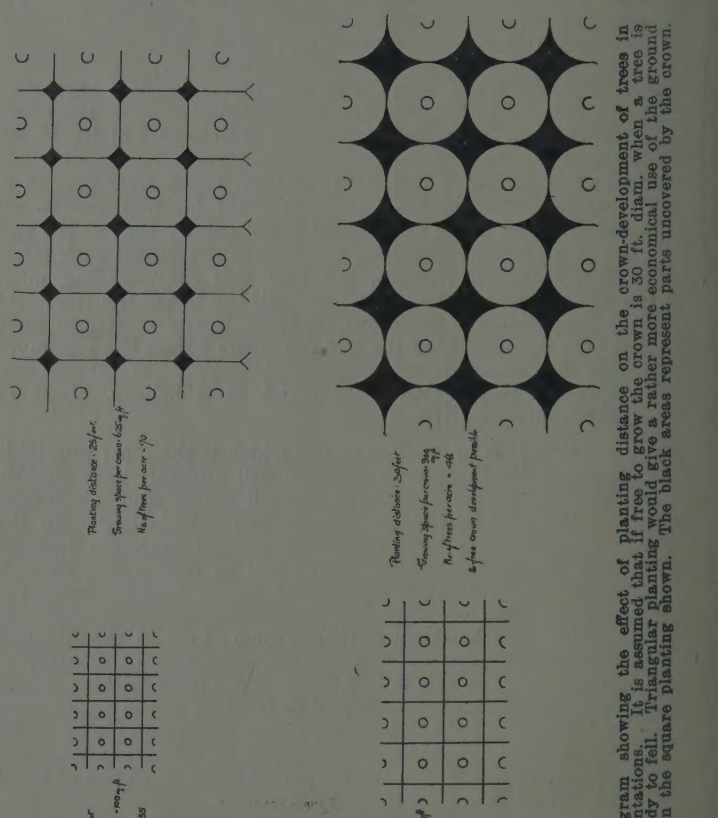
The effect of planting distance on space for crown development.
Planting distance - 10 feet
Growing space per crown - 100 sq ft
No. of trees per acre - 435
Planting distance - 15 feet
Growing space per crown 225 sq ft
No. of trees per acre - 194
Planting distance - 20 feet
Growing space per crown 400 sq ft
No. of trees per acre - 109
Planting distance - 25 feet
Growing space per crown 625 sq ft
No. of trees per acre - 70
Planting distance - 30 feet
Growing space per crown 900 sq ft
No. of trees per acre - 48
Space for crown development possible

FIG. 3.—Diagram showing the effect of planting distance on the crown-development of trees in plantations. It is assumed that if free to grow the crown is 30 ft. diam. when a tree is ready to fell. Triangular planting would give a rather more economical use of the ground than the square planting shown. The black areas represent parts uncovered by the crown.

and even 15ft. will usually prove too close. At these distances trees overcrowd and shade each other too much, and competition between them is too severe, especially when more than a single row of trees is set. I think it best, from

all points of view, to adopt 25ft. as a minimum planting distance, when only a single row is being set. If two or more rows are being planted then 30ft. should be the minimum distance, for then the competition between trees is much more severe (Fig. 3). Willow growers will probably

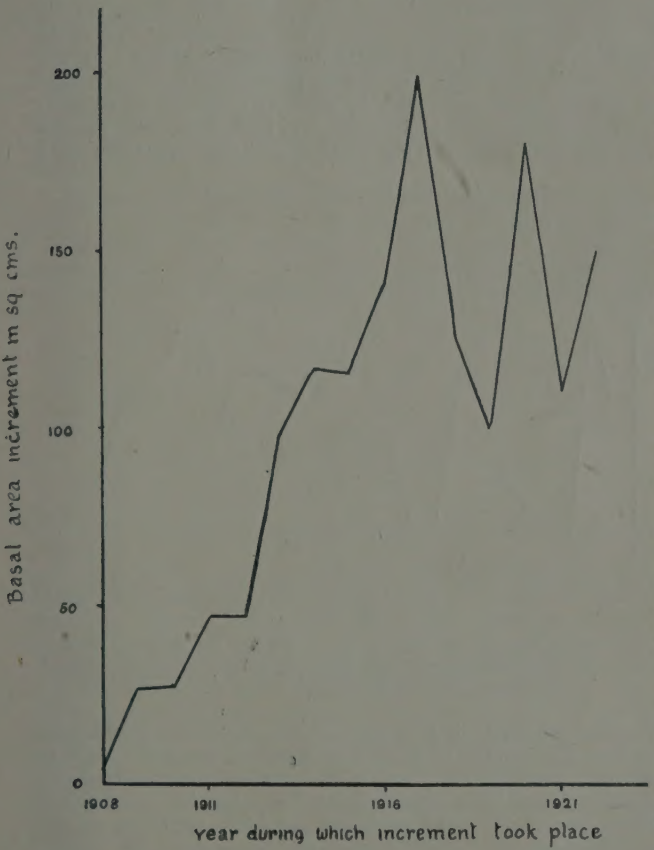

FIG. 4.—Curve showing annual increment in area at the base of the main stem of a Cricket Bat Willow. Note the irregular but continued falling off from the maximum after 10 years' growth. This is to be associated with the cramping of the crown by neighbouring trees.

never be entirely agreed on this matter. In forestry statistics would be collected to show approximately what is best; but in willow growing with an extremely divided ownership of the trees, it is probably very difficult to arrange to do anything such as this. Accordingly my advice is to resist

temptation to overcrowd trees, respect the willow as a plant, and carefully choose the sites to be planted up and only use really good vigorous sets.

The rate at which a tree forms timber may be studied by drawing a curve showing the annual increment in volume or basal area of the main stem. Fig. 4 is such a curve, showing the annual basal area increment throughout the life of a cricket bat willow. The tree from which this curve was drawn was one of a single line planted along a hedge-row at 15ft. intervals. It can be seen from the curve that the annual increment rises in amount until 10 years after planting, when there is an irregular, but permanent decline from the maximum. This decline probably coincides with

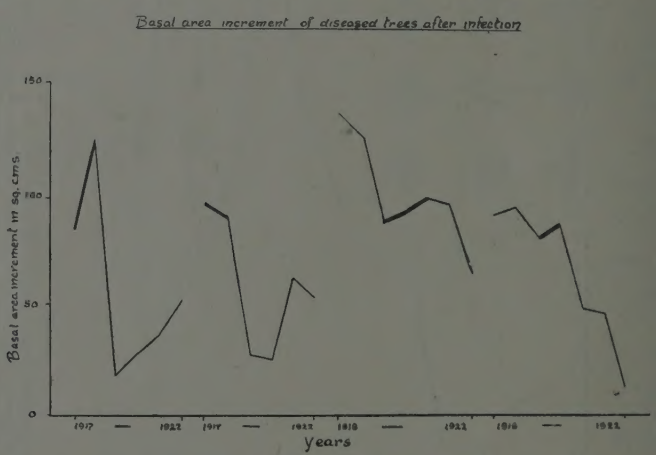

FIG. 5.—Similar curves to that in Fig. 4 for four trees affected by the watermark disease. Infection occurred where the line is thickened. Note the subsequent drop in increment, especially when compared with the healthy tree in Fig. 4.

the time when, owing to competition with its neighbours, the tree was unable to extend root and crown sufficiently to maintain the rate of growth already attained. Had the adjacent trees been removed at 10 years the amount of increment would have probably at least kept up to the maximum shown. The curves in Fig. 5 show the annual basal area increment for trees affected with the watermark disease and felled in 1922 when 9-10 years old. The curves cover the last five to seven years of the life of the tree and show the very much lower rate at which increment occurs after infection. The fall in increment is not necessarily

continuous, two of the trees showing a slight but not very successful tendency to recover; such recovery would only be temporary.

It may be noted before leaving this subject, that both from the point of view of regularity of income and utilisation of space, the most economic arrangement is to be obtained by growing an uneven rather than an even aged crop of trees. Fig. 6 illustrates this. Here the trees are arranged to be felled every five years in a fifteen year rotation. It can easily be seen that by having trees of various sizes in the row it might be possible to adopt a slightly closer planting distance than, say, 30ft. and still be able to have the advantages of free crown development. In this case the trees are set 25ft. apart.

Manures.—It may be asked sometimes whether or not ground that has grown one or more crops of willow should be manured. When thinking on this subject it should be remembered that the tree willows naturally colonise ground which is liable to be refreshed every year by the silt deposited

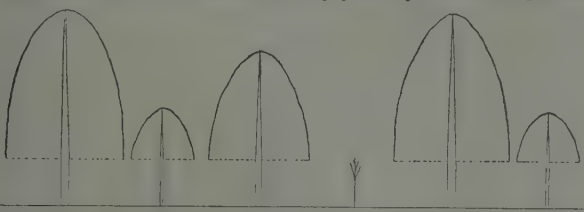

FIG. 6.—Diagram showing the greater space for crown-development with an uneven-aged crop.

from flood water, and is therefore subject to more or less regular manurings. Accordingly trees grown on land subject to floods may never need any manuring at all, especially if the soil is good. If, however, crop after crop is taken off ground that is not naturally manured the soil will be impoverished in time exactly as is the case with an agricultural crop. It seems to me that where the fields along which willows are planted are kept in a good and proper state of fertility the question of manuring will not need to be considered. It might come up, however, where this is not the case. I have never yet read or heard of anyone who applied manures to cricket bat willows, but it is quite probable that this has been done. The only published experiments in connection with the manuring of willows have been made on osiers. An osier bed is, of course, a very different thing to a plantation of cricket bat willows. The type of crop is quite different and also the soil is used much more intensely by the crop. In an osier bed all plants

but willows are counted as weeds; but in a plantation of cricket bat willows grass grows freely, often to a sufficient extent to be cut for hay or afford grazing. The wider apart the trees are planted the more will this be so. It should be realised that the more the soil is exploited for subsidiary purposes such as these the severer are the conditions for the willow and the greater is the need to keep up carefully the fertility of the soil.*

Manurial trials with osiers were reported on by Fenton (†) in 1923. He found that in the beds experimented with. certain combinations of manures had a definitely beneficial effect, raising both crop production and the profit obtained. These beds were on a clay subsoil and the best results were obtained with a mixture of Sulphate of Ammonia, Kainit and Superphosphate. Sulphate of Ammonia applied alone greatly increased the yield. Hutchinson (‡), another investigator, published results in 1924 which appeared to show that lack of nitrogen and phosphorous had the greatest effect in depressing growth of osier willows and that therefore nitrogenous and phosphatic manures would be most likely to yield the best results. There is, it seems to me, every reason to believe that the fertilisers which stimulated the growth of osier willows would also stimulate that of the cricket bat willow, and it merely remains to determine the extent to which it is worth while to apply them. That can only be told by actual trial in carefully controlled sample plots from which really comparable results could be obtained. Until the results of such trials are available willow growers can only use their own judgment and make such experiments as they think advisable.

Disease.—I have attempted so far to deal with what appeared to me to be some of the more important points in connection with willow cultivation. It is now necessary to say a little about disease and the relation between disease and methods of cultivation. Plants may succumb to disease either because they inherit a natural weakness towards it or because they have grown in so bad an environment that they become weak and unable to resist it. With regard to the cricket bat willow it has as yet hardly been questioned as to whether or not strains occur inheriting weakness or resistance to disease and for the time being this matter can be

* It is notorious that where grazing is carried out under forest trees the growth is poor: the same will presumably apply to willows. The injurious effect of grass covering the roots of orchard trees is also to be remembered.

† E. W Fenton, Journ. Min. Agri., August, 1923, p. 440.

‡ H. P. Hutchinson, Ann. Rep. of the Agr. Hort. Res. Station, Long Ashton, Bristol, 1924.

left on one side. It is, however, obvious to everyone who has keenly observed willows that disease must often be induced by growing in a bad environment, i.e., in the wrong way or in the wrong place. This a matter which comes home to every willow grower and one to which he can with profit pay attention. Merely to take care to grow willows in the right way is to take a very great step to prevent disease. In this connection good cultivation may be summarised in three short sentences, to which later it may be necessary to add a fourth:—

(1) Plant good sets.
(2) Plant them in suitable carefully chosen soil.
(3) Give them plenty of growing space.

The mere observance of such rules as these, however, does not guarantee freedom from disease. Epidemics arise from time to time which mere ordinary attention to cultivation is quite unable to check, and when this happens the time has come to arrive at a closer understanding of the needs of the crop and of the disease affecting it.

Diseases fall roughly into two classes. (1) those due to physiological disturbances, such as are produced by frost, drought, bad soil conditions and so on: (2) those caused by animal or plant parasites. Diseases in the latter class often really belong to the first, for sometimes parasites only attack trees, to any significant extent, when the trees have been weakened by some bad conditions under which they are living. It is for this reason that good cultivation is so essential. Willow growers should remember that to grow trees under any conditions that are unsuitable is to ensure that they shall be more susceptible to disease than they naturally are, and to guarantee that should disease be about the trees so planted will have every opportunity of succumbing to it.

I shall not try to give any sort of list of the possible animal or plant parasites causing diseases of the willow. Most of them are not important as a rule, and except on rare occasions only interest the specialist. There is, however, one important disease at present very prevalent, to which I feel it necessary to refer; this is, of course, the so-called Watermark Disease with which many, if not all, here are probably acquainted, some perhaps only too well. I do not propose to go into any great details with regard to this disease, which I have dealt with previously on more than one occasion.[1] It suffices to say that the disease is

(1) W. R. Day, The Watermark Disease of the Cricket Bat Willow, Clarendon Press, 1924.
W. R. Day, The Essex County Farmers' Year Book, 1925.
W. R. Day, The Essex County Farmers' Journal, October, 1926.

one of an exceptional type in this country, and is caused by bacteria which live in the wood in the vessels which carry the sap from the roots to the leaves. These vessels they block up and so prevent the sap rising; further, they produce poisonous conditions in any sap that does rise. This combined stoppage and poisoning of the sap causes the leaves to wilt and die, anad finally the death of much of the part of the tree affected. The newly-dead brown leaves are a familiar sight in districts affected by the disease, and first appear chiefly during June and July. Affected parts usually try to produce a second crop of leaves, but these do not survive except on the thicker branches and main stem, which may become clothed with these "water shoots." Fungi act as secondary parasites, helping to kill the diseased and wilting parts, but they are of no real primary importance.

Several important questions must now be asked concerning the disease, the answers to which are only partly known.

First, how does infection enter the tree and by what means is it carried?—Infection enters the tree through wounds so far as has yet been demonstrated. Also it enters through the crown of the tree and not through the root. It is probably quite possible to infect a tree through the root, but infection does not in Nature appear ever to enter in this way, and while the bacteria are commonly to be found in the root, it can often be demonstrated that it was through the crown that they entered. The only wounds that it has been possible to find generally distributed on willows and through which infection might enter are made by small insects in the ~~higher~~ twigs, and it appears to be through these that the bacteria enter the tree, and presumably it is by these insects that the infection is carried. Several observations seem to show that infection is also distributed by wind and rain. This is made possible by the occurrence of exudations of bacteria through the holes made by the insects in emerging and by any other wounds. These exudations occur during the time the trees first die back, in the early summer.

Smaller

The answer to the first question is, therefore, not definite. It is only known that artificially inoculation has not been successful, except through wounds, and it is assumed that this is true in Nature also. Insects, wind, and rain are the suspected carriers of infection, and the insects are regarded as being, perhaps, the chief means by which the disease enters the tree. Further research is urgently needed to help clear up this matter, accurate

information upon which would greatly assist in deciding what measures of control should be taken against the disease.

Second, at what time does infection take place?—This has never been proved, but evidence can be brought forward to show that trees become infected in the spring of the same year that dying back takes place. It is quite certain that it is during the late spring and early summer of this year that the parasite spreads through the host. Infection experiments have shown that not longer than eight weeks is required to produce the dying of the leaves; in Nature the time is probably much shorter. We should know, however, during exactly what period trees become infected, and further research is required to decide this.

Third, do any cultural conditions favour disease?—No proof has been forthcoming that they do, but probably only for lack of research. Observation in the field has seemed to show that trees which are overcrowded, and which grow on heavy and wet or sodden soil, tend to be especially susceptible to disease. On the other hand, slow-growing trees on sites definitely too dry have remained free from disease, even though in the neighbourhood of abundant infection; and also fast-growing trees, planted on good "hollow bottom" land beside a stream but on a bank three or four feet above it, and therefore especially well drained, have remained free from infection (these observations date to 1924). This seems to show that the disease may be controlled to some extent by especial care to planting distance and planting site, but further careful work is needed to find out to what extent this is really the case.

Fourth, what measures may be taken against the disease?—In attempting to say, how infection enters the tree, how it is carried and at what time actual inoculation takes place, it has had to be admitted that much remains to be done before any clear and definite answer can be given. It follows, then, that any preventative measures taken may easily prove to be somewhat inadequate until these important matters are decided. In spite of this much may be done to control and prevent the spread of disease, and very much more can be done than has been attempted up to the present. One reason why this disease has spread so widely during the last ten years or more is that insufficient attention has been paid to the general cultivation of trees, and that when trees have become infected they have not been removed or even cut down, but have been neglected and allowed to stand until and after they are dead. Not to act so, is to

invite trouble. *Every diseased tree is not merely a loss in itself, it is also a potential source of loss in that it provides a centre from which infection can spread throughout the neighbourhood.* It follows, then, that all infected trees should be felled, and as far as possible destroyed. It costs money to do this, of course, but such cost is to be regarded as part of the premium necessary to insure against the much bigger loss that will occur as more and more trees are rendered worthless.

It may be worth while now to summarise the history of the disease, when it will be seen what is the best time to fell infected trees.

Late Spring and early Summer. — Probable time of infection. Definitely the time when disease spreads through the tree, and also the time when exudations occur, from which infection can be spread further.

Summer—Disease spreads and trees die back.

Autumn and Winter.—Disease apparently resting, but probably spreading slowly within infected trees.

Spring.—The above cycle starts again.

It should be obvious from this that the time to destroy infected trees is as soon as signs of infection appear. There should be no trouble in identifying the disease, the water-mark being a very plain and definite symptom by which diagnosis can be made, and there should be no excuse for the neglect of this very simple but necessary measure of hygiene.

The measures to be taken in order to control the disease are few and simple. They are four, including the three rules I have already given:—

(1) Plant good sets.

(2) Plant them in suitable, carefully-chosen soil.

(3) Give them plenty of growing space.

(4) Fell and destroy all infected trees as soon as the disease appears on them.

Observance of these rules is the first step towards prevention. Other things may prove to be necessary in the future, but these have yet to be attended to in far too many cases. Conscientious care for and attention to plantations is the great need of the present day.

The necessity of future research.—One cannot end a lecture on the cultivation of the cricket bat willow without stressing how great is the need for further research into its cultivation; this applies especially to that side of

cultivation affecting disease, and especially the watermark disease. I have no doubt not only that there is much to be found out, but that much useful information, well worth the while, would really come to light if only sufficient time and money were available to carry out quiet and continued study into the various problems connected with the cultivation of this tree. Such work as this is sometimes difficult to organise, but willow-growers will be well advised seriously to consider whether it is not possible to at least get further investigations begun into the more pressing problems, the failure to find a solution for which hinders and makes unprofitable the cultivation of this valuable, and one may perhaps say nationally, most necessary tree.

Reprinted, by permission, from the Essex County Farmers' Union Year Book, 1928.